



Science Applications International Corporation  
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(NASA-CR-196558) AR&C GROUND  
PROJECT PLANNING TECHNICAL  
SCHEDULES ANALYSIS Final Report, 22  
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This Final Report summarizes the activities performed by Science Applications International Corporation (SAIC) under Purchase Order H-78575B "AR&C Ground Project Planning Technical Schedules Analysis". This Purchase Order provided technical services to the Marshall Space Flight Center's AR&C Business Management Office for the period April 22, 1994 through December 31, 1994.

The major thrust of the services provided to the AR&C Business Management Office consisted of two major tasks. One involved the orientation and training of Ms. Carolyn Clifford, the new AR&C Program Analyst. Ms. Clifford was familiarized with the current AR&C programmatic and technical activities, the layout and logic of the AR&C schedules, and trained in the usage of FastTrack Schedule. The second was the development and baselining of schedules for the ground program.

In addition, SAIC participated in a May 1994 Quarterly Review, an August 1994 Status Review, a November 1994 Quarterly Review, monthly schedule inputs to the Lenoir Report, and weekly Systems Engineering & Integration meetings. Specifically, this participation involved interfacing with engineering personnel to obtain data for the development of detailed technical schedules and providing in-depth analysis of product need dates and the inter-relationships of technical tasks and schedules. For the Quarterly Reviews, each schedule was developed with the collaboration of the responsible design engineers and then presented by that engineer at the review.

During this period of performance, due primarily to budget uncertainties, the AR&C project has continued to re-plan for a ground program. The program currently utilizes six top level and detailed schedules to capture product need dates and the inter-relationships of technical tasks. These schedules include the Top Level, Systems Engineering, Hardware Development, Software Development, System Verification, and the Near Term Milestones. The Top Level schedule is used most often to depict the status of the program, while the other schedules are used to track the lower, more detailed levels of work being performed by AR&C personnel and to feed the Top Level schedule.

The re-planning for a ground program required frequent, major changes to the program schedules. Due to this frequency of changes, the program office decided to allow unlimited modification to the Top Level schedule until the May 1994 Quarterly Review at which time this schedule was baselined at Mr. Gene Beam's request. Due to the fact that the detailed schedules capture data at such a low level we did not present these

schedules at the May Quarterly and allowed unchallenged changes to be made until September 1994 at which time they were baselined. This additional time was necessary due to the changeable nature of the program and to aid the responsible design engineers in planning low level programmatic and technical activities on a time scale that they felt confident they could meet.

Since the schedules have been baselined, changes that impact the delivery of an item, the start date of another activity, or the date of the final system test require a "AR&C Schedule Change Request Form" to be filed with the AR&C Business Management Office. That change must be justified by the responsible design engineer and approval must be gained from Mr. Dallais Pearson, the AR&C Chief Engineer, and Mr. Gene Beam, the AR&C Project Manager. The baselining of the schedules has provided a discipline in the system and has dramatically decreased the number of schedule changes. This has forced the engineers involved to be more aware of the schedule impacts and the inter-relationships of the total program.

A need continues to exist in the AR&C Business Management Office for technical schedule analyses. However, the analyses need to be expanded to involve the use of schedules as a tool for problem tracking, program control, and budget analysis. This broadened activity would be extremely useful to the AR&C program in determining budget impacts based on schedule changes and would prove invaluable for the continued development and implementation of the AR&C ground program. In addition, the program could use a management information system that integrates the costs and schedules and provides tracking of the procurement and financial data. SAIC has extensive experience with scheduling and networking for the AR&C program and has a full understanding of the current state of the program. SAIC is fully capable of delivering this expanded level of management and technical analyses in a timely manner.

Attached are the latest baselined AR&C program schedules. These schedules have been significantly improved in continuity and logic when compared to those schedules that existed in April 1994. While the transition from a flight program to a ground program has been difficult and has required constant revision of the schedules, the attached schedules accurately and thoroughly depict the current AR&C ground program.

## NEAR-TERM SCHEDULE

## PROGRAM/CENTER:

AR&C/MSFC  
(GROUND PROGRAM)

## PROJECT/CONTRACT:

AR&C - N/A

**FY 1994**

- Jun: STATUS REVIEW (starts), FINAL IP (ends)
- Jul: DOTS READY (starts)
- Aug: FINAL SRD (starts)
- Sept: MATRIXx SW (starts)

**FY 1995**

- Oct: PMR (starts)
- Nov: GPS DIGITAL MODEL SW (starts)
- Dec: TPDM (starts)
- Jan: FRL DIG OPEN/CLOSED LOOP CAP (starts)
- Feb: PRELIM IDD (starts)
- Mar: VGS FFF MODEL (starts)
- Apr: GPS RF SIMULATOR (starts)
- May: PRELIM GPS REL NAV FILTER (starts)
- Jun: COMMERCIAL SDU (starts)
- Jul: UNIT TESTER (starts)
- Aug: VGS TEST COMPLETE (starts)
- Sept: QUARTERLY REVIEW (starts)
- Oct: FINAL GPS REL NAV FILTER (starts)
- Nov: QUARTERLY REVIEW (ends)
- Dec: MATRIXx SW (ends)

- \* GSE GPS Processor deleted

\*\* Commercial FEU changed to Commercial SDU

A/O: 11/30/94

# AR&C Ground Program Master Schedule

Activity Name	CY 91				CY 92				CY 93				CY 94				CY 95				CY 96				CY 97			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
PROGRAM MILESTONES																												
	Project Plan	◆																										
	Program Review	◆																										
	Preliminary SRD	◆																										
	Final SRD	◆																										
SYSTEMS ENGINEERING																												
System Requirements																												
System Integration																												
	Initial Operations Requirements	▼																										
	Nite Hawks Installed & Operating	▼																										
	Closed/Open Loop Sensor Tests	▼																										
Documentation																												
	DOTS Ready																											
	Dig Open/Closed Loop Capability	▼																										
HARDWARE DEVELOPMENT																												
Video Guidance Sensor (VGS)																												
	Final SRD	▼																										
	Prelim SRD	▼																										
	Prelim IP	▼																										
Three Point Docking Mechanism																												
Electronics																												
Mechanism																												
Cables																												
On Board Computer																												

\* Ground Support Equipment deleted from HW Dev.

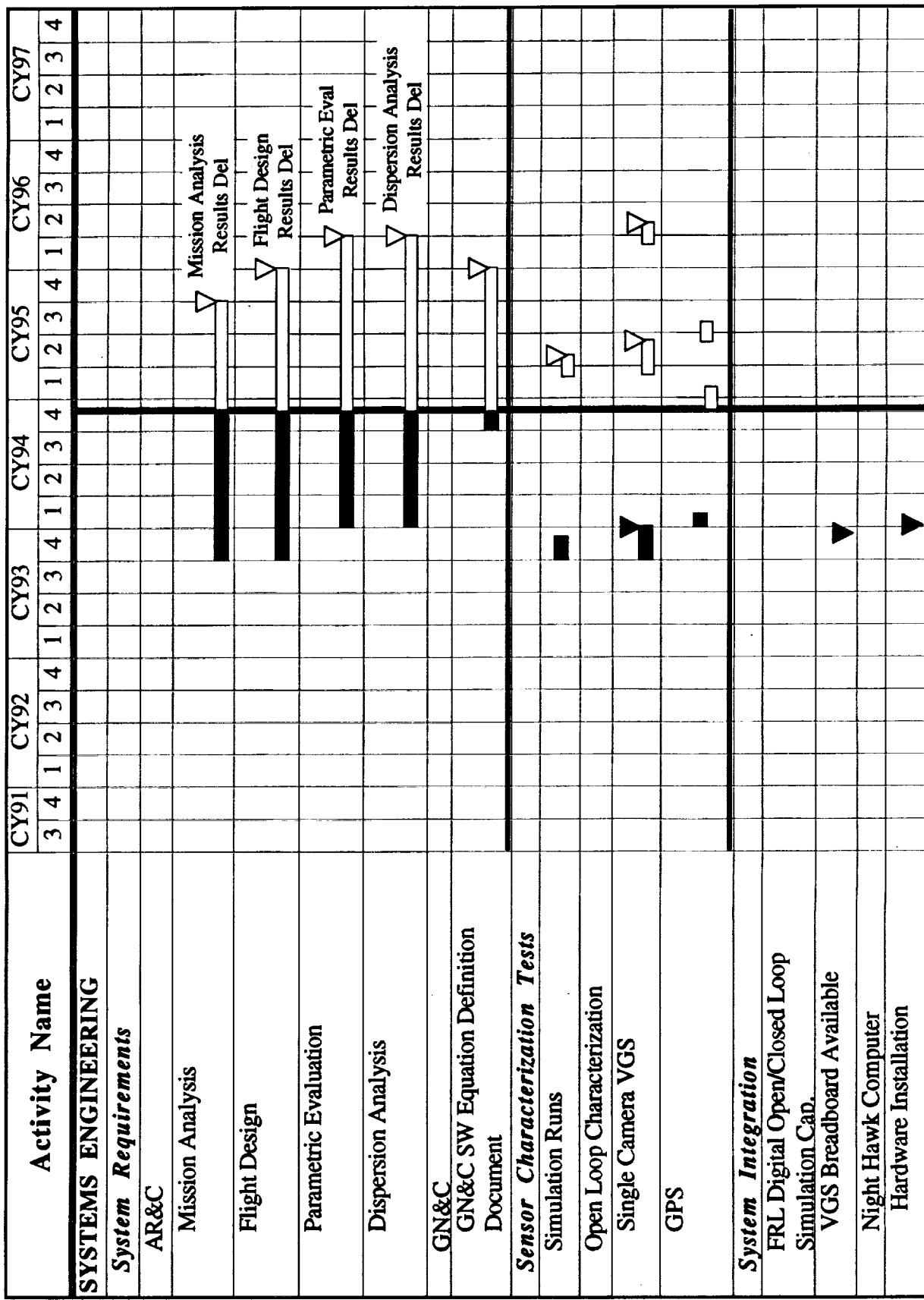
AR&C Ground Program Master Schedule

The Gantt chart illustrates the project timeline from CY 91 to CY 94. The tasks are categorized as follows:

- System Hardware:**
  - CY 91: Del GPS Digital Stat Model to FRL
  - CY 92: Final SW Mgt/Dev Plan, MATRIXx Del
  - CY 93: GPS RF Simulator
  - CY 94: SW Test Plan, Deliver OBC Figt SW to FRL
- Software Development:**
  - CY 91: Final SW Mgt/Dev Plan, MATRIXx Del
  - CY 92: GPS RF Simulator
  - CY 93: VGS SW Model Del
  - CY 94: MARCSIM System Ready
- System Verification:**
  - CY 92: Documentation Complete
  - CY 93: Test Procedures
  - CY 94: System Tests Comp, Test Reports
- System Test:**
  - CY 94: Final Rpt Complete

Ground Support Equipment deleted from HW Dev.

## AR&C Systems Engineering Schedule - Baseline



# AR&C Systems Engineering Schedule - Baseline

Activity Name	CY91	CY92	CY93	CY94	CY95	CY96	CY97
	3	4	1	2	3	4	1
	4	1	2	3	4	1	2
Sim & DOTS S/W Porting							
OBC Commercial SDU Available							
Fortran GN&C S/W Installed							
Operational TPDM Available							
Statistical Model GPS Available							
Graphical User Interface Displays							
RF Simulator HW Delivered							
Initial AR&C System Development Cap.							
Preliminary Flight GN&C S/W Delivered to FRL							
Final GPS Nav Filter Delivered							
FRL Ready for Flight GN&C S/W, OBC & Flight Sensors							
Full FRL AR&C System Test Capability							
Preliminary Flight S/W Delivered							
Form, Fit & Function OBC Delivered							
Flight VGS Delivered							
Begin Statistical Evaluation of AR&C Systems							
<b>Project Level Documentation</b>							
Level II Documentation							
Implementation Plan							
Level III Documentation							
	Prelim						
							Final

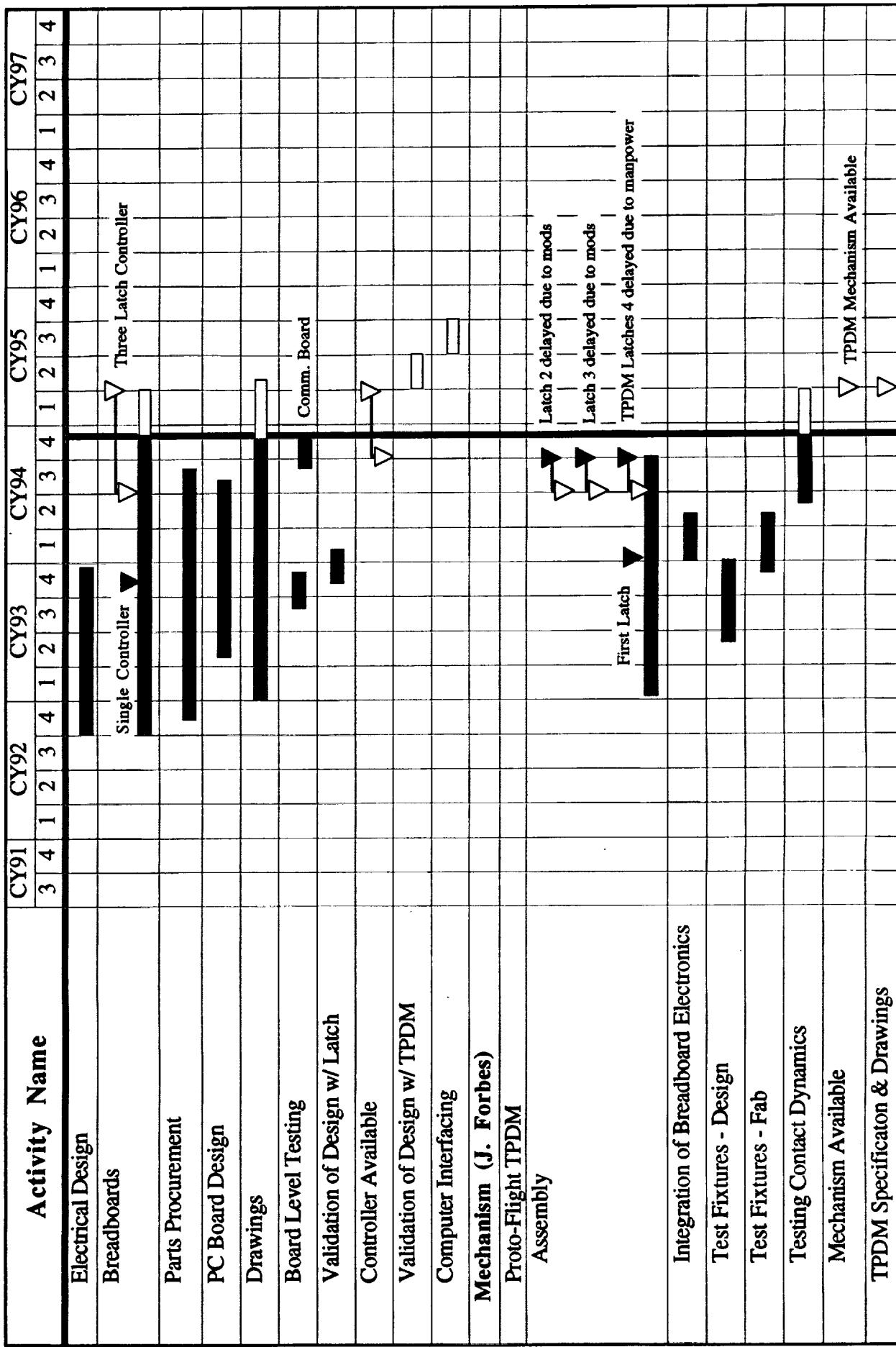
AR&C Systems Engineering Schedule - Baseline

Activity Name	CY91	CY92	CY93	CY94	CY95	CY96	CY97							
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
System Requirements Document (SRD) (C. Cruzen)														
Verification Plan							Prelim	Final						
Verification Requirements & Specification Document														
Verification Requirements Compliance Document														
Interface Definition Document (IDD)							(1)	Prelim	Final					

## AR&C Hardware Development Schedule - Baseline

Activity Name	CY91				CY92				CY93				CY94				CY95				CY96				CY97					
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
<b>HARDWARE DEVELOPMENT</b>																														
<i>Video Guidance Sensor (VGS) (R. Howard)</i>																														
Single Head Breadboard Model																														
FFF Model VGS																														
Design/Packaging																														
Procure/Build																														
Cabling																														
FFF VGS Model Available																														
VGS Sensor Specification & Drawings																														
Test																														
Flight Model VGS																														
Design/Packaging																														
Procure/Build																														
Cabling																														
Flight VGS Model Completed																														
VGS Sensor Specification & Drawings																														
Test																														
<i>Three Pt Docking Mechanism (TPDM)</i>																														
Electronics (B. Jacobs)																														
Requirements																														
Specifications																														

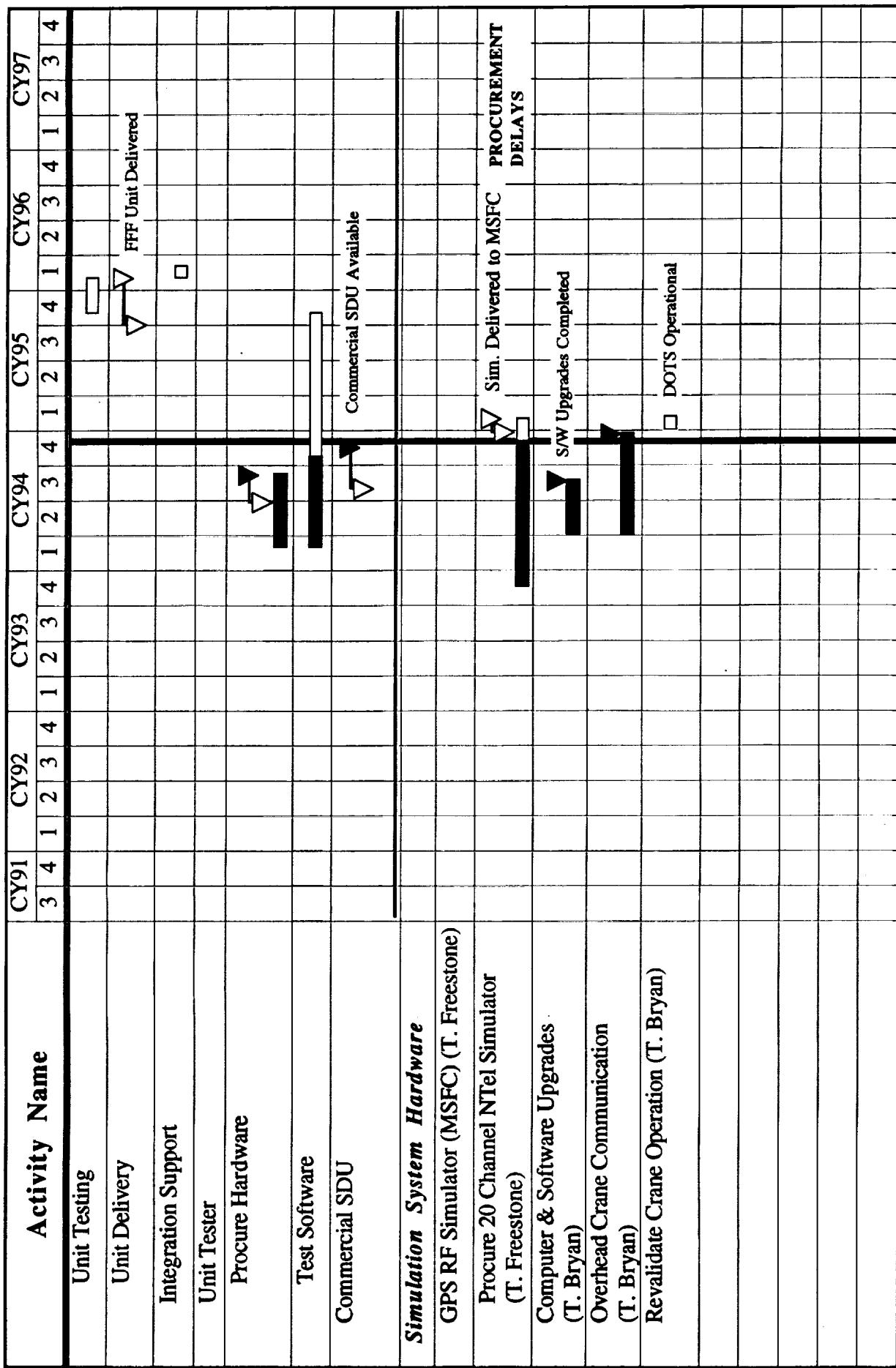
## AR&C Hardware Development Schedule - Baseline



## AR&C Hardware Development Schedule - Baseline

Activity Name													CY97					
	CY91			CY92			CY93			CY94				CY95	CY96			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>Cables (T. Deitrich)</b>																		
<b>AR&amp;C OBC (R. Humphries)</b>																		
Form, Fit & Function Unit																		
Prototype Computer																		
Design																		
Procure Hardware & Software																		
Breadboard Fab/Test																		
Test Software																		
Prototype Fab/Test																		
Mechanical Design																		
Procurement																		
Boards																		
Chassis																		
Power Supply																		
Design																		
Breadboard Fab/Test																		
Prototype Fab/Test																		
Cabling																		
Unit Assembly																		

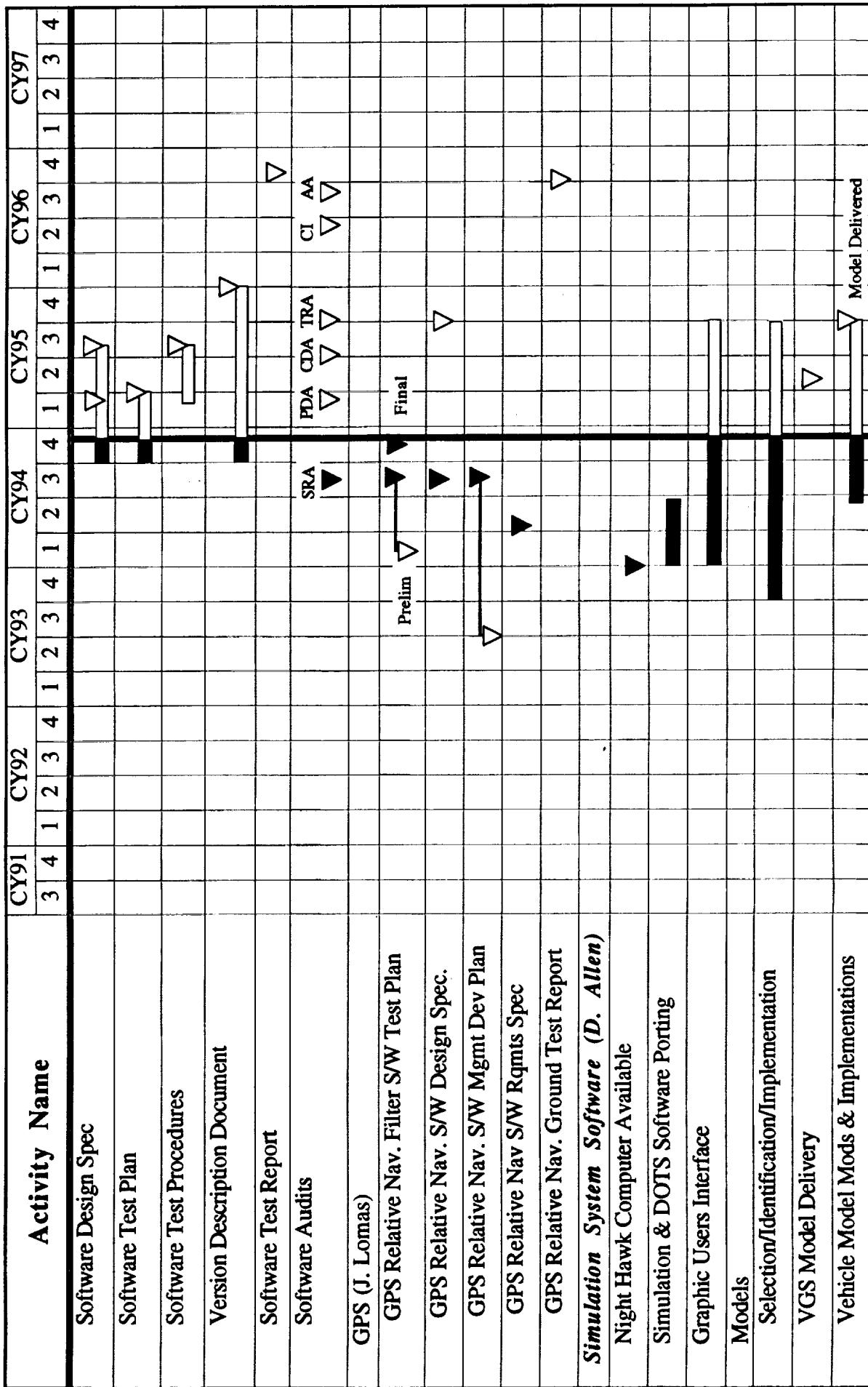
AR&C Hardware Development Schedule - Baseline



## AR&C Software Development Schedule - Baseline

Activity Name	CY91	CY92	CY93	CY94	CY95	CY96	CY97
	3	4	1	2	3	4	1
	4	1	2	3	4	1	2
<b>SOFTWARE DEVELOPMENT</b>							
<i>OBC Software (B. Thornhill)</i>							
Develop OBC Software Requirements							
Design & Code OBC Software							
MATRIXx							
Delivery							
Training							
Global Positioning System (GPS) (Lomas)							
Develop S/W Reqs & Preliminary Algor.							
S/W Put on Processor							
Software Devt & Testing at MSFC							
Software Evaluation & Data Analysis							
Deliver Relative Nav. S/W							
Commercial SDU OBC Available							
Flight OBC Available							
OBC Software Integration & Test							
OBC Software Updates/Verifications							
Documentation							
Software Management/Development Plan							
Software Requirements Spec							

## AR&C Software Development Schedule - Baseline



## AR&C Software Development Schedule - Baseline

Activity Name	CY91				CY92				CY93				CY94				CY95				CY96				CY97			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
Environmental Model Mods & Implementations																												
Propulsion Model Mods & Implementations																												
IMU Model Mods & Implementations																												
GPS Digital Simulation																												
GSP Statistical Model of a GPS Receiver																												
Documentation																												
Model User's Guide																												

Model Delivered

# AR&C System Verification Schedule - Baseline

Activity Name	CY91	CY92	CY93	CY94	CY95	CY96	CY97
<b>SYSTEM VERIFICATION</b>							
<i>Test Integration</i>							
Installation & Prep of OBC Computer							
Installation & Prep of VGS							
Installation & Prep of TPDM							
FRL & Prep of Sim Sys Computer							
Test Procedures							
<i>System Test</i>							
Design Verification							
Full System Demonstration							
OFF Nominal Conditions (Fault Tolerance)							
Installation & Prep Nav Filter							
Test Eval & Sim Lab Technical Support							
System Test Complete							
Test Reports Complete							
<i>Final Report</i>							
Data Evaluation							
Final Report							

Nov 30, 1994